

Nowell K. 2002. Revision of the Felidae Red List of threatened species. *Cat News*:4-7.

Keywords: endangered species/extinction risk/Felidae/method/Red List/status

Abstract: The original system of evaluating species status, in use up to 1994, classified species as Extinct, Endangered, Vulnerable, Rare, Indeterminate or Insufficiently Known. These category definitions were largely subjective. By the 1980s it was becoming evident that a more objective and quantitative method of comparing species' extinction risk was needed.

Revision of the Felidae Red List of Threatened Species

by Kristin Nowell, IUCN/SSC Red List Felidae Authority*

The original system of evaluating species status, in use up to 1994, classified species as **Extinct, Endangered, Vulnerable, Rare, Indeterminate or Insufficiently Known**. These category definitions were largely subjective; for example, the definition of Endangered in 1993 was: “Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating” (Groombridge 1993). By the 1980s it was becoming evident that a more objective and quantitative method of comparing species extinction risk was needed.

There are five sets of criteria for Critically Endangered, Endangered and Vulnerable. A) is Declining Population, as determined by a threshold rate of taxa total population decline per specified period of time. B) is Small Geographic Range, based on threshold total species range sizes. C) is Small Population Size, with threshold numbers of mature reproductive individuals in the total taxa population. D) is Very Small Population Size, and E) is Quantitative Analysis, an extinction risk analysis such as a PHVA (Population and Habitat Viability Assessment).

In considering the criteria for application to the Felidae, it is apparent that some are not appropriate. Most cats are fairly wide ranging, and do not meet the low thresholds for (B) Small Geographic Range Size. Only the Iberian lynx exists in such low numbers of breeding individuals to meet the thresholds for (D) Very Small Population Size, and it is also the only species for which

rangewide quantitative extinction risk analyses (E) have been carried out (Ferrerias et al 2001, Rodriguez et al 2002). I wanted to avoid the category Data Deficient, following the new guidelines stating that this category was to be assigned only when data are so uncertain that any category of threat is plausible (IUCN 2001: 25). However, for most species quantitative range-wide data is lacking for species population size (C) and rate of change (A), the remaining two criteria.

Increased implementation of species population monitoring systems may in the future allow application of criterion (A) to felids, and arguably population trend is the most important type of data cat specialists should seek to collect, especially for populations at risk of extinction. But given that the most common

Table 1. IUCN Red List categories applied to the Felidae for the 2002 Red List

Category	Estimated effective population size (N_e) ¹
Critically Endangered	$N_e < 250$, declining and fragmented
Endangered	$N_e < 2,500$, declining and fragmented
Vulnerable	$N_e < 10,000$, declining and fragmented
Near Threatened	Near qualification for Vulnerable (N_e 10,000-50,000) ²
Least Concern	Not qualifying for any of the above (yet) ²

¹ N_e = estimated number of mature breeding individuals in the wild.

² I used an estimated effective population size of 50,000 as the dividing line between Near Threatened and Least Concern.

Table 2. Classification of felid species on the 2002 IUCN Red List

Critically Endangered	Endangered	Vulnerable	Near Threatened	Least Concern
Iberian Lynx	Andean Mountain Cat	African Golden cat	Geoffroy's Cat	Bobcat
	Borneo Bay Cat	Asiatic Golden Cat	Jaguar	Canada lynx
	Snow Leopard	Black-footed cat	Lynx	Caracal
	Tiger	Cheetah	Manul	Jaguarundi
		Chinese Mountain Cat	Oncilla	Jungle cat
		Clouded leopard	Pampas cat	Leopard
		Fishing cat	Puma	Leopard cat
		Flat-headed cat	Sand cat	Margay
		Guigna		Ocelot
		Lion		Serval
		Marbled cat		Wildcat
		Rusty-spotted cat		

data currently available for wild cat species consists of estimates of density and geographic range, I decided to use these as a crude but quantitative basis for estimating species population size, criterion (C). When no density estimates were available from studies, density was estimated from home range size, or from data on other similar-sized felids. The densities used were very low and conservative as they were applied over large areas, and studies have found that there is an inverse relationship between density and size of area surveyed (Schonewald-Cox et al 1991). Estimates of species geographic range size were taken from the Cat Action Plan (Nowell and Jackson 1996). Range area was separated into protected and non-protected. Density in non-protected areas (the majority of most species ranges) was reduced to 20% of the estimated protected range density.

Based on previous studies of reproduction in wild cat populations (Nowell and Jackson 1996: 214), the resulting population size was then halved to represent effective population size. Effective population size is a measure of the genetic or reproductive population, excluding non-breeding adults and juveniles (Kimura and Crow 1963). The Red List categories measure population in terms of "mature individuals," which are "known, estimated or inferred to be capable of reproduction" (IUCN 2001: 10).

The effective population size thresholds for each Red List category are shown in Table 1. Details on the estimation of effective population sizes for each species are in a Microsoft Excel spreadsheet which can be downloaded from the Cat Action Treasury website: <<http://www.felidae.org/REDLIST/2002catsp.xls>>. The figures used are very rough estimates indeed, and are not intended for publication or any other use other than as a basis for Red List classification.

The August 2001 classification, which underwent a limited review among members of the Cat SG Core Group, was just published in October 2002 as the 2002 IUCN Red List (Table 2). Twenty-five species, or almost 70% of the cat family, are included in the online Red List <<http://www.redlist.org/>>. Seventeen, or almost half of the Felidae, are in the top three threatened categories.

Table 3 shows changes in species classification from the previous 2000 Red List (which actually dates from a 1996 evaluation by me and then Cat Specialist Group Chairman, Peter Jackson, carried out as the Cat Action Plan was being published). All changes to this original listing reflect an increasing threat to cat species; no species was downgraded in level of threat. Most taxonomic groups have seen the number of species listed increase since 1996 (<<http://www.redlist.org/info/tables/table2.html>>).

Table 4 compares felid categorization with canids (wild dogs) and the carnivore family as a whole, showing that the cat family contains more species of top conservation concern.

The Red List also includes subspecies and populations. Twenty-three felid subspecies were listed in 1996, and are still included on the 2002 Red List (to see them, click the "Subspecies" box on the lower right of the Red List search page (<<http://www.redlist.org/search/search-basic.html>>)). Subspecies and populations (national and regional) need

Table 3. Changes in felid species Red List classification

Species	Red List classification	
	2002	2000
Iberian lynx	Critically Endangered	Endangered
Andean mountain cat	Endangered	Vulnerable
Borneo bay cat	Endangered	Vulnerable
Chinese mountain cat	Data Deficient	Vulnerable
Marbled cat	Data Deficient	Vulnerable
Rusty-spotted cat	Data Deficient	Vulnerable
Black-footed cat	Vulnerable	Least Concern
African golden cat	Vulnerable	Least Concern
Asiatic golden cat	Vulnerable	Near Threatened
Fishing cat	Vulnerable	Near Threatened
Sand cat	Near Threatened	Least Concern
Lynx	Near Threatened	Least Concern
Pampas cat	Near Threatened	Least Concern
Manul	Near Threatened	Least Concern
Puma	Near Threatened	Least Concern
Geoffroy's cat	Near Threatened	Least Concern

Table 4. Felid, Canid and Carnivore species on the 2002 Red List

Red List category	Taxa (# and % of species)		
	Felidae (36)	Canidae (35)	Carnivora (270)
Critically Endangered	1 (2.7%)	2 (5.7%)	5 (1.9%)
Endangered	4 (11.1%)	1 (2.9%)	31 (11.5%)
Vulnerable	12 (33.3%)	2 (5.7%)	40 (14.8%)
Near Threatened ¹	8 (22.2%)	3 (8.6%)	20 (7.5%)
Data Deficient	0	9 (25.7%)	19 (7%)
Percent of taxonomic group in top 3 categories	47%	14%	28%

¹ Some canid and carnivore species were evaluated under an earlier version of the Red List which included the category "Conservation Dependent," which has since been scrapped. I included "CD" species in the Near Threatened category for this table.

to be re-evaluated for the next Red List update, in August 2003. In the near future I will be contacting Cat SG members about information needs for this process. Meanwhile, members are invited to contact me or the Cat SG Chairs, Drs Urs and Christine Breitenmoser, with comments on the 2002 Red List, especially if you feel changes should be made for species classification on the next Red List (2003). Please also take time to review the extensive text fields included in the Red List database. The Cat SG is responsible for their accuracy, and they are easy to change and update if you send me revised text.

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“Red List Authorities” are established for all taxonomic groups in the IUCN Red List. No species is included in the IUCN Red List unless it has been evaluated by an appointed Red List Authority and/or by the Red List Standards Working Group (a group established under the Red List Programme Subcommittee). Kristin Nowell was approved as the Felidae Red List Authority in 2001 by the Cat SG’s Core Group.

The Red List Explained

The IUCN Red List is the world’s most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and all regions of the world. With its strong scientific base, the IUCN Red List is recognized as the most authoritative guide to the status of biological diversity.

The overall aim of the Red List is to convey the urgency and scale of conservation problems to the public and policy makers, and to motivate the global community to try to reduce species extinctions.

Who uses the Red List?

The Red List is used by government agencies, wildlife departments, conservation-related non-governmental organizations (NGOs), natural resource planners, educational organizations, and many others interested in reversing, or at least halting the decline in biodiversity.

Uses of the Red List:

- Draws attention to the magnitude and importance of threatened biodiversity
- Identifies and documents those species most in need of conservation action
- Provides a global index of the decline of biodiversity
- Establishes a baseline from which to monitor the future status of species
- Provides information to help establish conservation priorities at the local level and guide conservation action
- Helps influence national and international policy, and provides information to international agreements such as the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

The Red List can answer commonly asked questions such as:

- How threatened is a particular species?
- How important is this species to conservation?
- What are the threats to a species?
- How many threatened species occur in a given country?
- How many known extinctions have there been?

How the Red List is compiled: The categories and their application

There are nine categories in the IUCN Red List system: *Extinct*, *Extinct in the Wild*, *Critically Endangered*, *Endangered*, *Vulnerable*, *Near Threatened*, *Least Concern*, *Data Deficient*, and *Not Evaluated*. Classification into the categories for species threatened with extinction (*Vulnerable*, *Endangered*, and *Critically Endangered*) is through a set of five quantitative criteria that form the heart of the system. These criteria are based on biological factors related to extinction risk and include: rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation.

For more detail see the Red List Categories and Criteria booklet *Version 3.1*:

<<http://iucn.org/themes/ssc/redlists/RLcats2001booklet.html>>

The Red List is based on information supplied by IUCN’s Species Survival Commission (SSC), a network of 7,000 experts on plants, animals and conservation issues, and data from a number of partner organizations. All bird data is supplied by BirdLife International. Collectively, this network holds what is the most complete scientific knowledge base on the biology and current conservation status of species.

Major analyses of the Red List were produced in 1996 and 2000. The 1996 List revealed that one in four mammal species and one in eight bird species face extinction, while the 2000 List confirmed that the global extinction crisis is as bad or worse than believed. Dramatic declines in populations of many species, including reptiles and primates were reported.

Numbers of threatened species on the Red List change from year to year, not only because new species are added to the list. Research scientists working around the world bring a constant flow of new information and this improved knowledge can result in species being upgraded to a higher threat category or, in cases where the situation is more optimistic than previously realised, downgraded to a lower threat category (see examples below). Other changes may be the result of taxonomic revisions, such as a species being re-classified as a subspecies and *vice-versa*. However, some species have moved into a different category as a result of a genuine change in conservation status (see examples below).

The IUCN Red List includes extinctions that have occurred since 1500 AD. For the 2002 Red List, a revision of the extinctions list resulted in 15 species being removed because they are con-

sidered to have become extinct before 1500 AD. Also, as with the threatened categories, species can sometimes move out of the Extinct category as a result of taxonomic changes or uncertainties such as the marbled toadlet (*Uperoleia marmorata*).

As the Red List expands to include complete assessments for the various taxonomic groups, a more detailed analysis of the statistics every four to five years will allow better comparison between years and a better understanding of the general trends in biodiversity over time. Targets have been set to assess all amphibians by 2003 (approximately 5,000 species); reptiles by 2005 (approximately 8,000 species); freshwater fish by 2005 (approximately 10,000 species), sharks, rays and chimaeras by 2004 (approximately 1,000 species); freshwater molluscs by 2004 (approximately 5,000 species). Plants, invertebrates and marine species will follow. By 2008 it is hoped that a worldwide biodiversity assessment will be possible.

Background to the *IUCN Red List of Threatened Species*

Biodiversity loss is one of the world's most pressing crises and there is growing global concern about the status of the biological resources on which so much of human life depends. It has been estimated that the current species extinction rate is between 1,000 and 10,000 times higher than it would naturally be.

Many species are declining to critical population levels, important habitats are being destroyed, fragmented, and degraded, and ecosystems are being destabilised through climate change, pollution, invasive species, and direct human impacts. But there is also growing awareness of how biodiversity supports livelihoods, allows sustainable development and fosters co-operation between nations. This awareness is generated through products such as the IUCN Red List.

Governments, the private sector, multilateral agencies responsible for natural resource use, and environmental treaties all need access to the latest information on biodiversity when making environment-related decisions. Information about species and ecosystems is essential for moving towards more sustainable use of our natural resources.

In 2000, the Red List combined animal and plant assessments into a single list for the first time (containing 18,000 species assessments). This, together with improved documentation for each species, means that the Red List is now too large to publish as a book. Instead, it is available in electronic format, on a specially designated, searchable website <www.redlist.org>. Updates to the Red List will be made every year from now on, and an updated analysis will be published in hard copy at least once every four to five years. A CD-ROM of the Red List will be produced probably every two years from 2003.

The Red List is produced by the IUCN Species Survival Commission (SSC) – a network of some 7,000 species experts working in almost every country in the world, and data from a number of partner organizations. Collectively, this network holds what is probably the most complete scientific knowledge base on the biology and current conservation status of species.

A brief history of the Red List

The IUCN Red List System was first conceived in 1963 and set a standard for species listing and conservation assessment efforts. For more than 30 years the Species Survival Commission has been evaluating the conservation status of species and subspecies on a global scale – highlighting those threatened with extinction and promoting their conservation.

Over time, however, IUCN recognised that a more objective and scientific system for determining threat status was needed, one that drew on advances in the science of conservation biology and other disciplines. There was also a need for a more accurate system for use at the national and regional level. The IUCN Red List Categories evolved over a four-year period through extensive consultation and testing with more than 800 SSC members, and the wider scientific community. The more precise and quantitative Red List Categories and Criteria were adopted by IUCN in 1994.

In 1988 all bird species were evaluated, and in the 1996 *IUCN Red List of Threatened Animals* the conservation status of every mammal species in the world was assessed for the first time. These were major milestones in conservation because not only was the overall status of mammals and birds determined, but a baseline was established from which to monitor future trends. For the 1996 list 5,205 species were evaluated resulting in 25% of all mammals and 11% of all birds being listed as threatened.

The system has since undergone further intense review and has been refined to ensure the highest standards of documentation (supporting information), information management, training, and scientific credibility.

The IUCN Red List Categories and Criteria are leading IUCN in new directions that will allow sophisticated biodiversity analyses, which will contribute to scientific discovery and to political policies related to conservation at local, national, and regional levels.

Improving the science behind the Red List

To improve the previous *ad hoc* process of listing species, Red List Authorities are being established for all taxonomic groups included on the Red List. In most cases, the Authority is the SSC Specialist Group responsible for a species, a group of species, or a geographic area. BirdLife International has been designated as the Red List Authority for birds and will liaise with the bird Specialist Groups and Wetlands International, where necessary. No new species will be added to the Red List until it has been evaluated by an appointed Red List Authority. All species on the list must be re-evaluated at least once every 10 years.

Taxonomic standards have been adopted and all species on the IUCN Red List should conform to these by the year 2003. Adherence to the documentation and taxonomic standards will bring greater credibility and transparency to listings, and allow better analyses of the findings.

Status assessments included in the IUCN Red List are also open to formal challenge. Petitions may be made against particular listings but only on the basis of the Red List Categories and Criteria and in reference to supporting documentation accompanying the listing. Petitions may not be made for political or economic reasons.